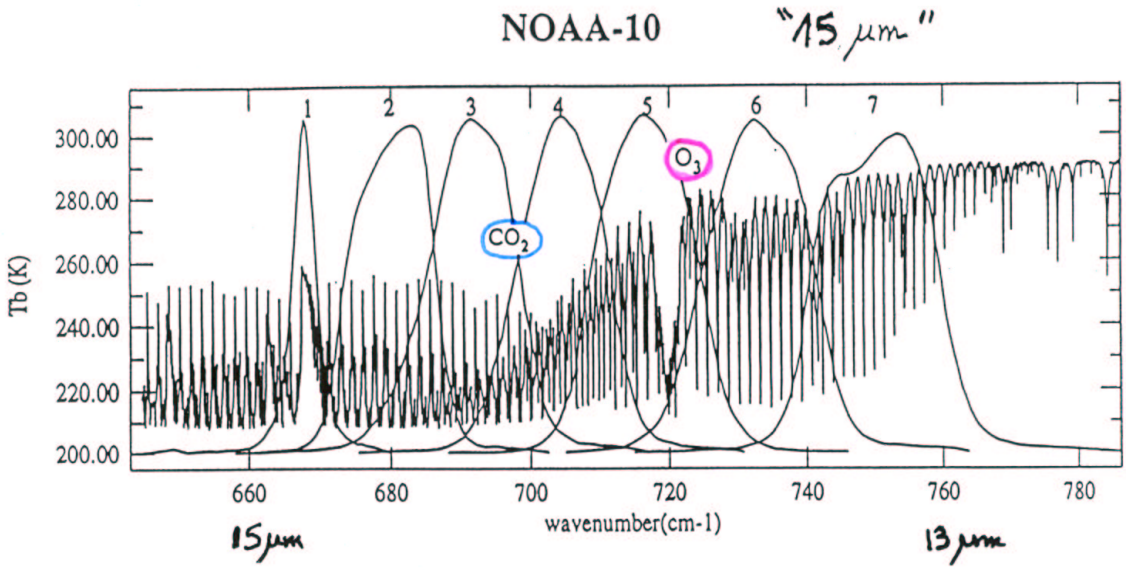
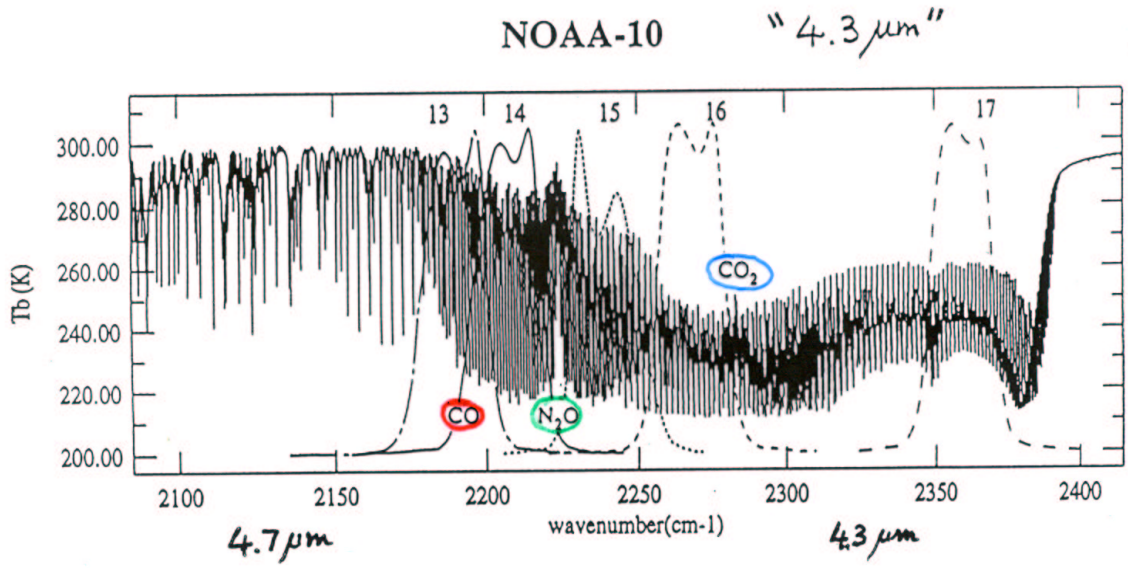
Four years of NOAA-10 retrieved C02 concentrations. Application to AIRS simulations

Alain Chedin AIRS science team meeting Sept. 2002

Locations of HIRS channels





CHANNEL	CO_2: + 5%	N_2O: +4%	CO: +40%	O_3: +35%	T_{50}: +1K [1]	T_{surf}: +1K
2	+0.15 ± 0.10			+0.08 ±0.05	+0.60 ± 0.04	
3	+0.00 ± 0.10			+0.10 ± 0.04	+0.50 ± 0.05	
4	-0.35 ± 0.15			-0.10 ± 0.04	+0.20 ± 0.05	
5	-0.50 ± 0.20			-0.35 ± 0.20	+0.15 ± 0.05	+0.04 ± 0.02
13		-0.25 ± 0.08	-0.25 ± 0.08			+0.45 ± 0.10
14		-0.40 ± 0.20	-0.10 ± 0.03			+0.30 ± 0.07
15	-0.14 ± 0.06	-0.35 ± 0.10				+0.10 ± 0.03
MSU2						< 0.10 [2]
MSU4					+0.15 ± 0.04	

Table 1. Sensitivities (in K) of HIRS and MSU channels to changes in various parameters

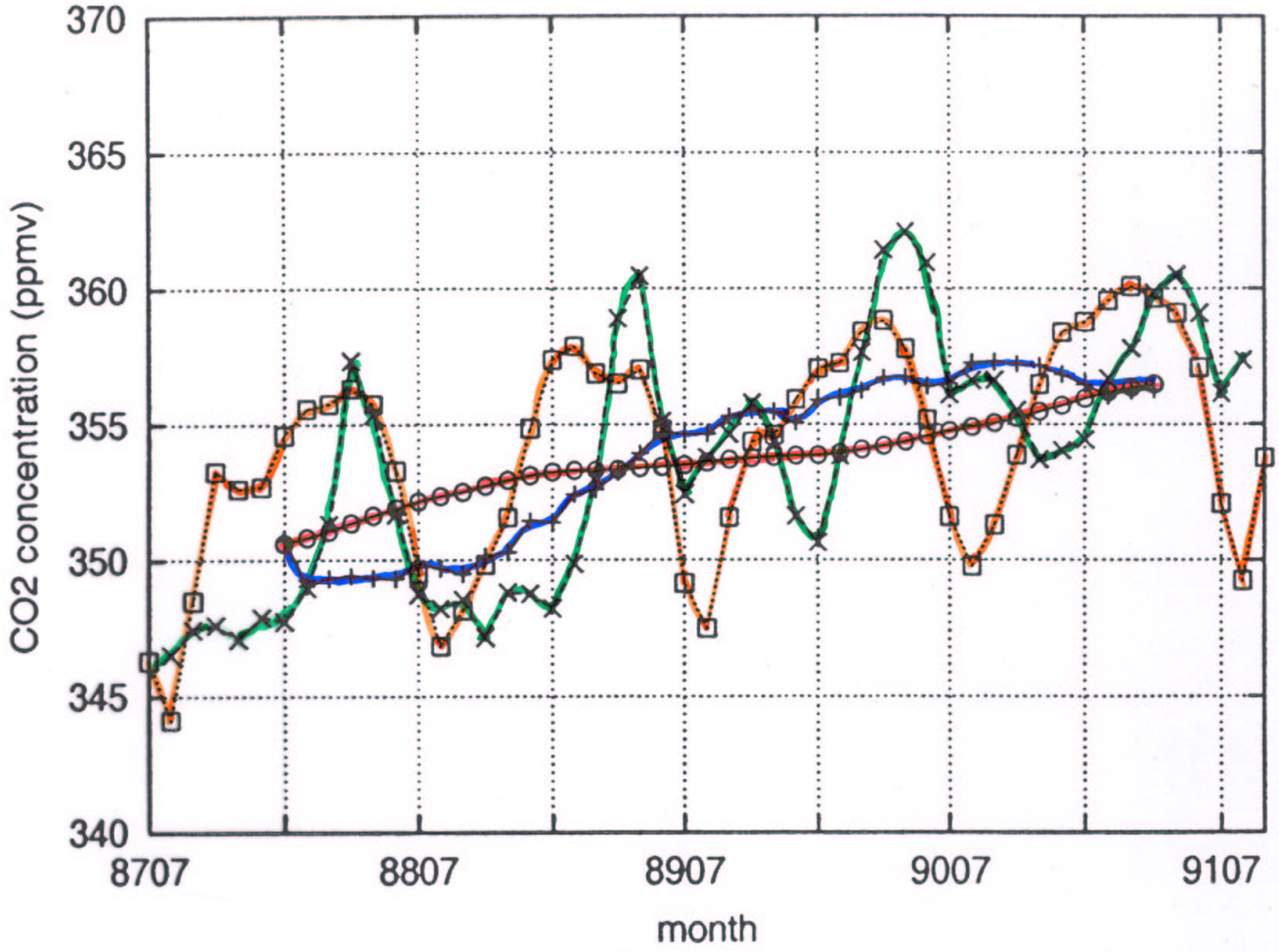
(1) Temperature increase of 1K for pressure levels less than 50 hPa

(2) over land

20N-60N

night

land

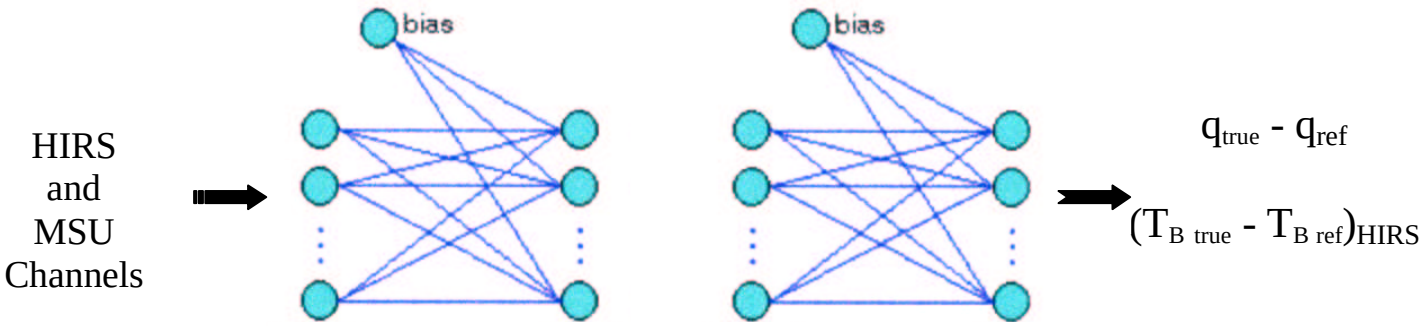


Cape Meares obs. [45N, 124 W] (seasonal)

GLOBAL VIEW- CO_2 (annual)

FIRST GLOBAL MEASUREMENT OF MID-TROPOSPHERIC CO_2 FROM NOAA POLAR SATELLITES THE INTERTROPICAL ZONE

- A neural network approach
  - Multilayer perceptron (Rumelhart, 1986)
  - Two hidden layers
  - Inputs: satellite observations (HIRS and MSU)
  - Outputs:
    - difference between true mixing ratio and a reference value for CO_2 (354 ppm)
    - difference between true and reference CO_2 brightness temperatures for HIRS channels

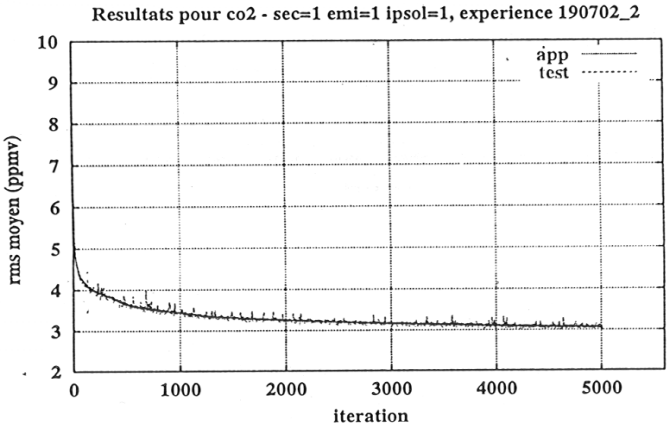


2 hidden layers

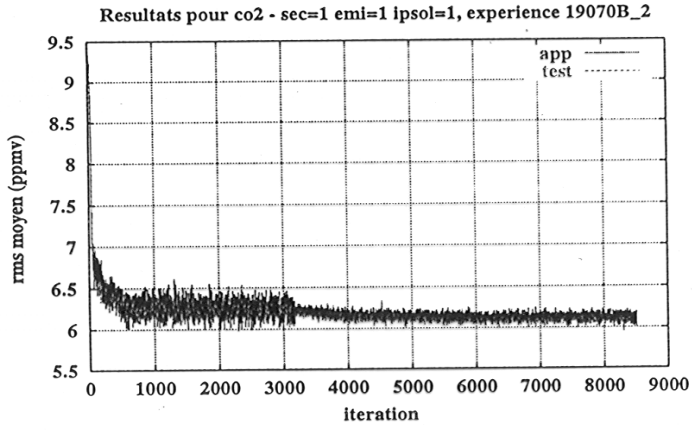
- Trained on the TIGR data set with variable q_{CO2}
- Noised T_B

Convergence of the Network

Without noise

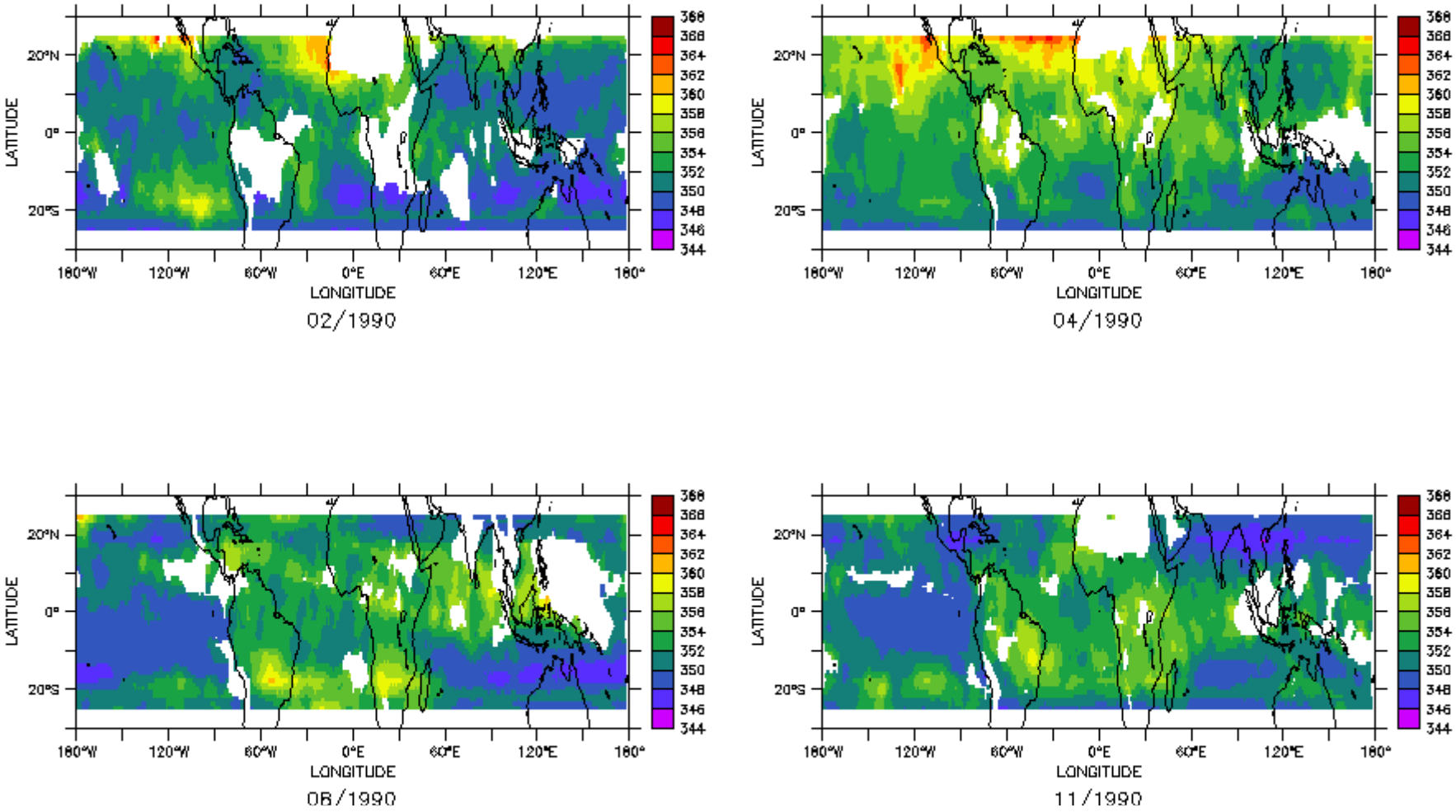


With noise



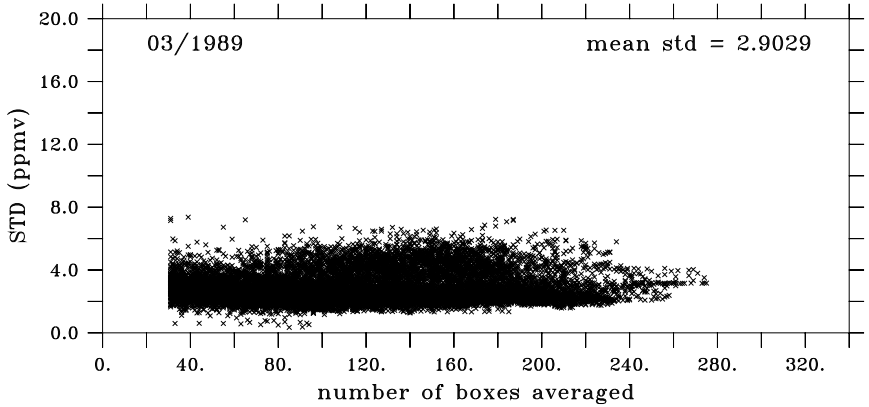
FIRST CO2 OBSERVATION FROM SPACE : NOAA POLAR SATELLITES

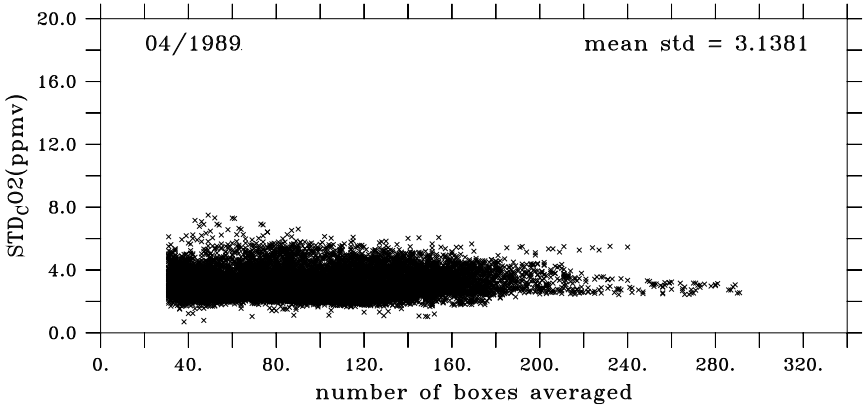
Time period covered : 07/87-07/91 – Monthly maps 5°x5° - Intertropical zone
Examples of results for 4 months (02/90; 04/90; 08/90; 11/90)

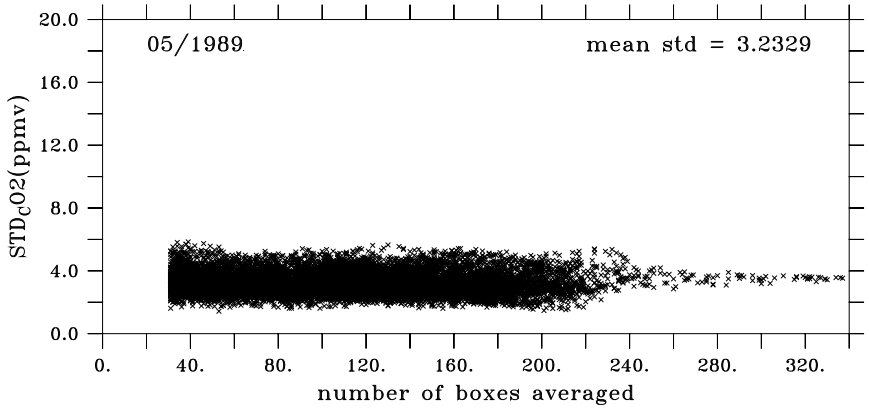


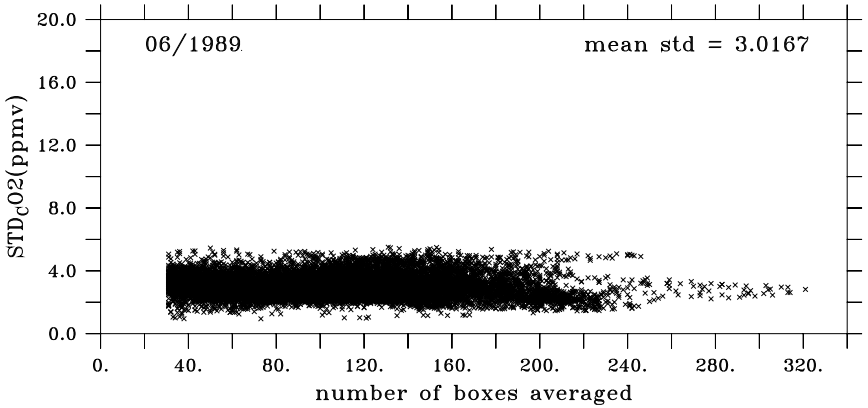
IPSL/LMD/ARA*

* Paper in preparation (A. Chédin, S. Serrar, N. A. Scott; 2002)


03/1989
mean std = 2.9029
STD (ppmv)
number of boxes averaged


04/1989
mean std = 3.1381
STDc02(ppmv)
number of boxes averaged


05/1989
mean std = 3.2329
STDc02(ppmv)
number of boxes averaged


06/1989
mean std = 3.0167
STDc02(ppmv)
number of boxes averaged

Aircraft observation of carbon dioxide at 8–13 km altitude over the western Pacific from 1993 to 1999

By HIDEKAZU MATSUEDA*, HISAYUKI YOSHIKAWA INOUE and MASAO ISHII, *Geochemical Research Department, Meteorological Research Institute, 1-1 Nagamine, Tsukuba-shi, Ibaraki-ken 305-0052, Japan*

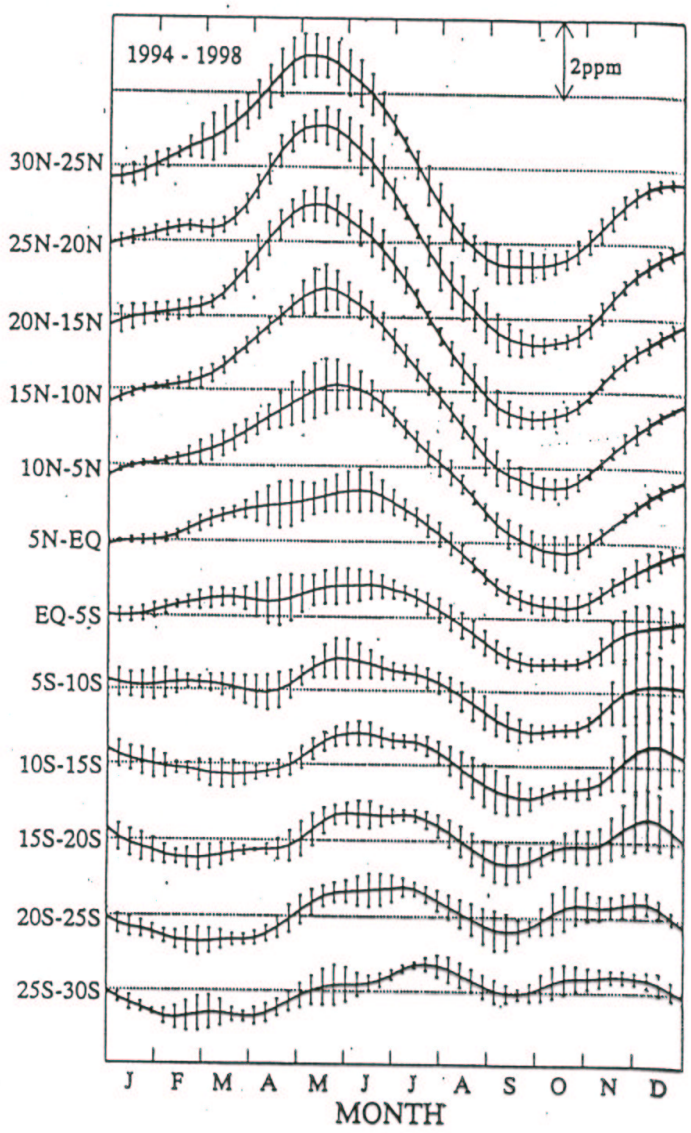
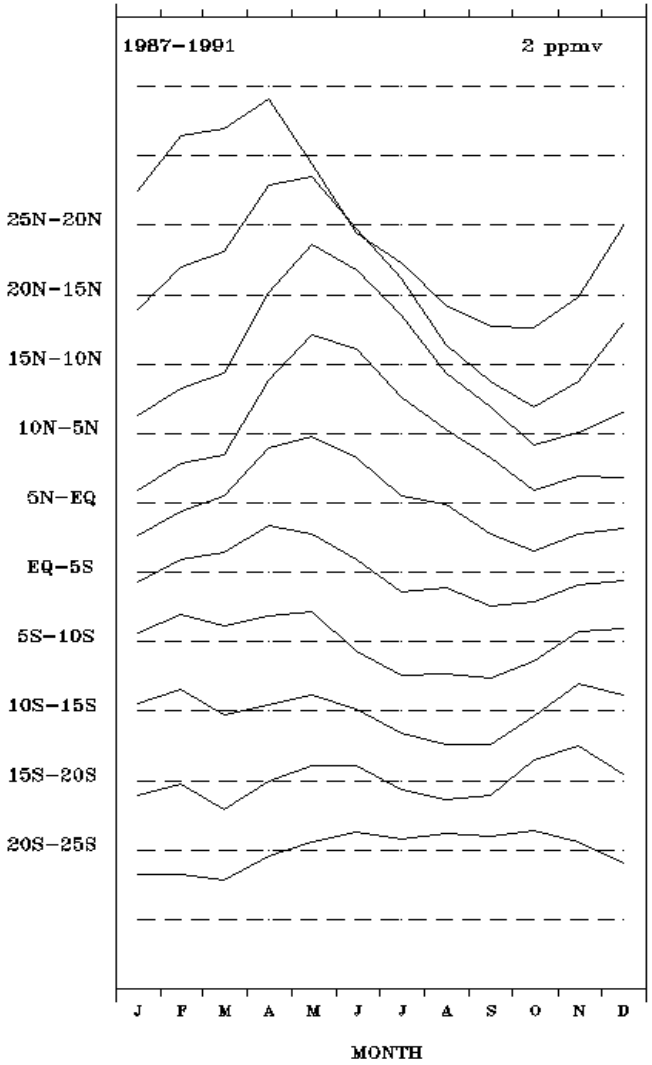
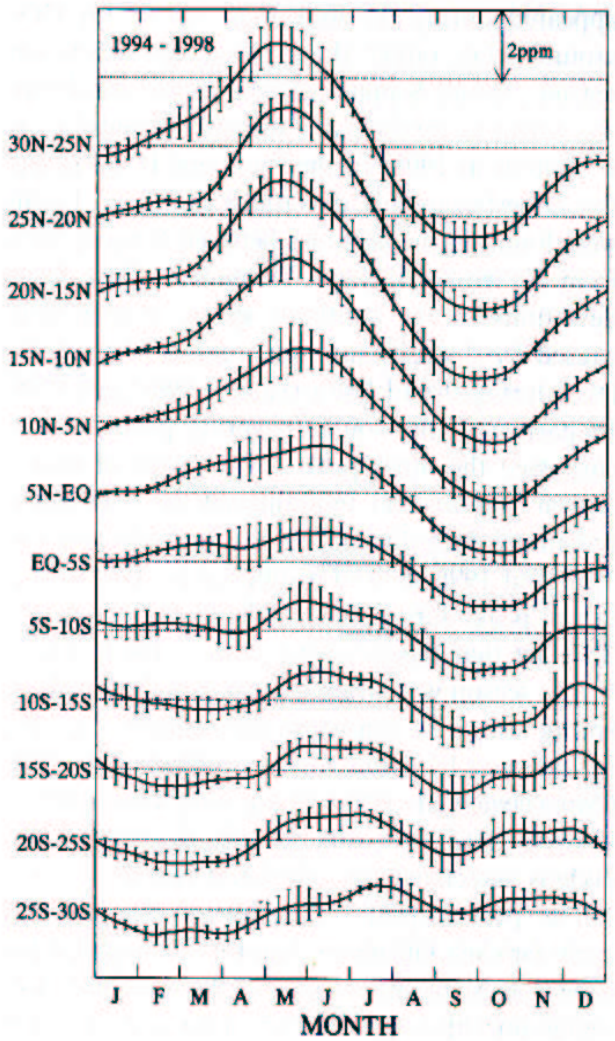


Fig. 8. The mean seasonal cycles for 12 latitudinal bands between 30°N and 30°S at 8–13 km over the Pacific during 1994–1998. The solid line represents the mean seasonality for 5 yr, while the error bars represent a range of ±1 standard deviation.





The mean seasonal cycle for 10 latitude bands between 25N and 25S
left: as retrieved by NOAA-10 (07/87-07/91)
right: as observed by commercial aircraft (1994-1998; Matsueda et al., 2002)

Application to AIRS

AIRS channels selection : the OSP method

For each pressure level :

1-Select the channels that best cover the level (by the CO2 Jacobian).

2-Reject the channels presenting a low ΔT_B (<0.05K).

3-Compute the STI ratio : $\frac{\text{CO2 signal}}{\text{interference}}$

H2O, N2O, CO, O3, ε and Ts signals

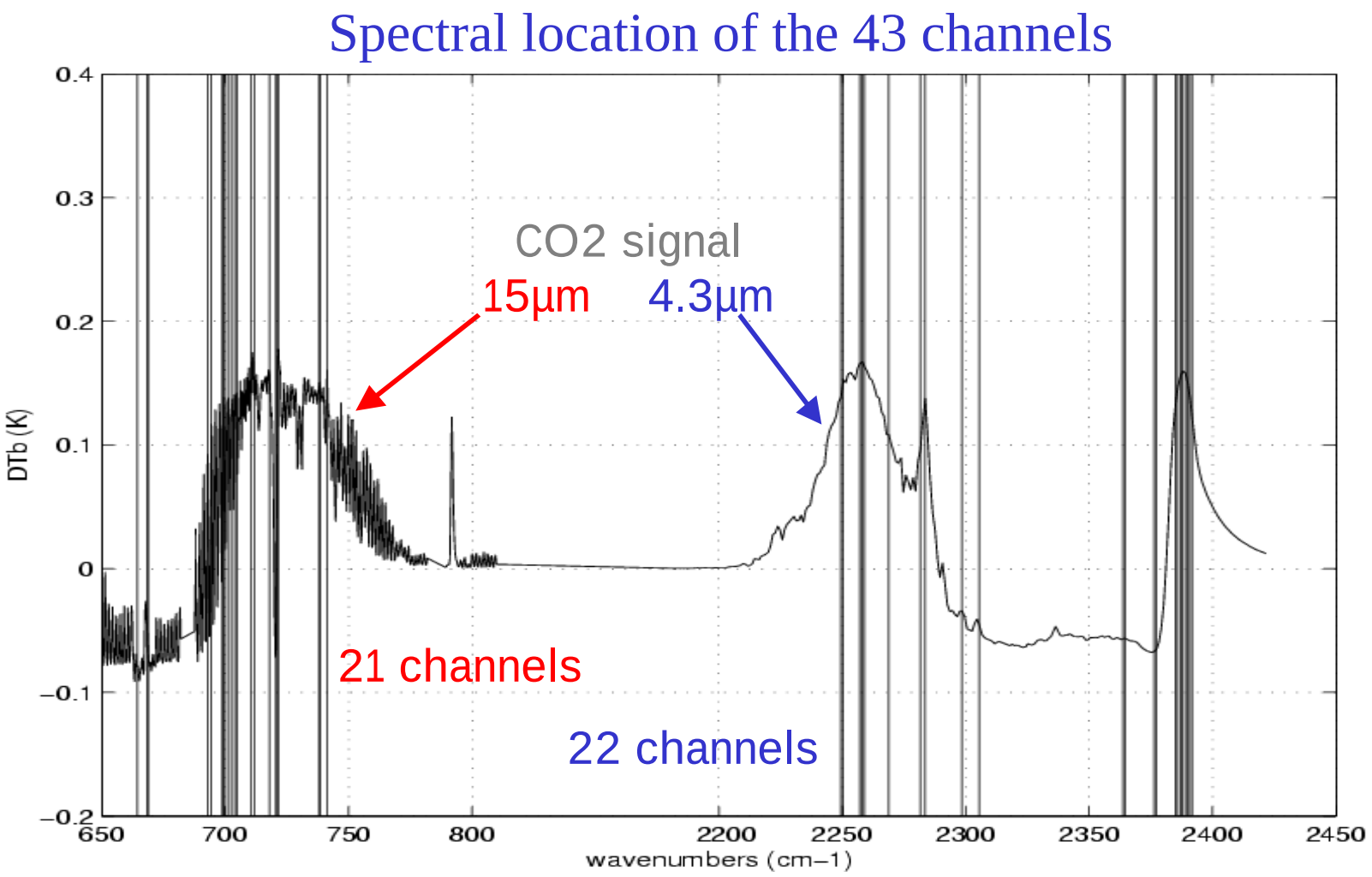
4-Order the channels and remove the channels presenting a too low ratio.

Crevoisier et al., 2002.
Submitted to Q. J. R. Meteorol. Soc.

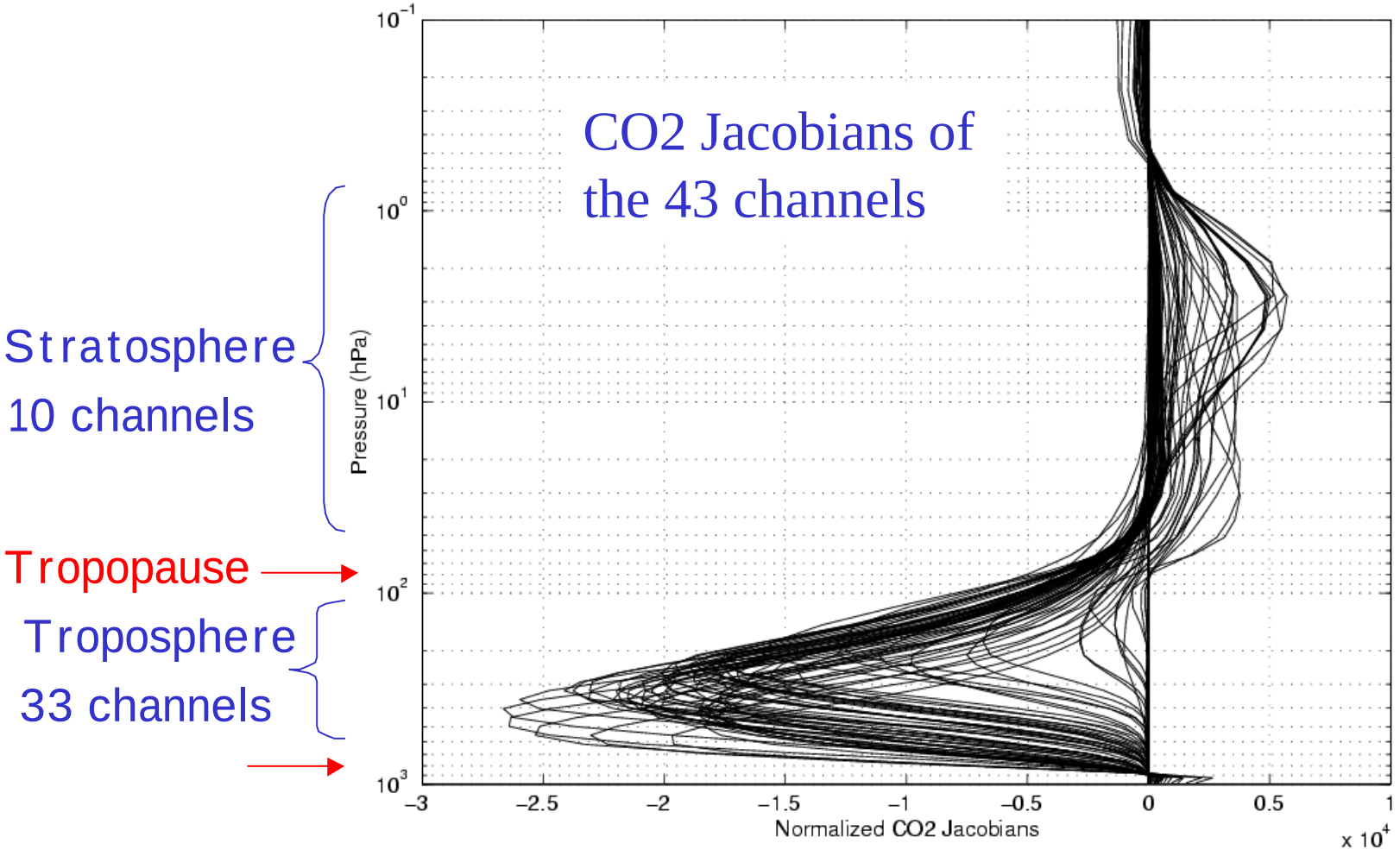
LMD/CNRS

I P S L

The 43 channels obtained with the OSP method.

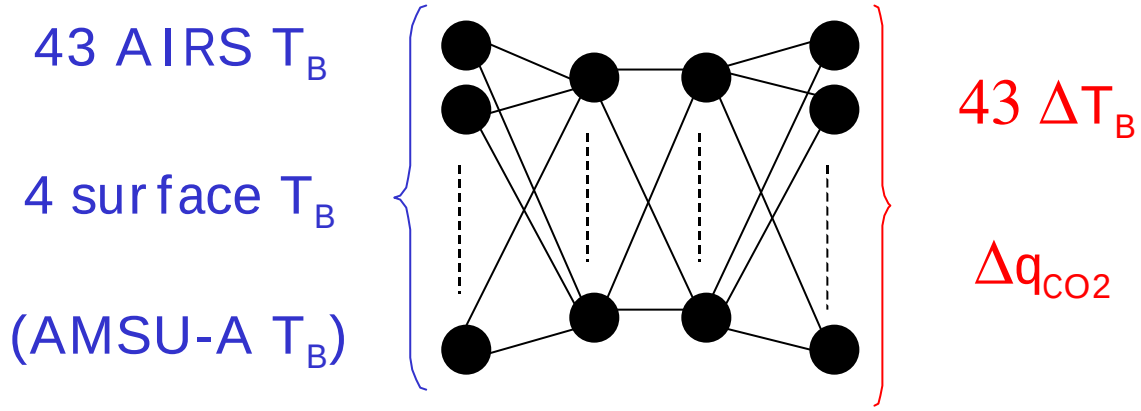


The 43 channels obtained with the OSP method.



Stand-alone approach for CO2 retrieval.

Based on a Neural Network approach.



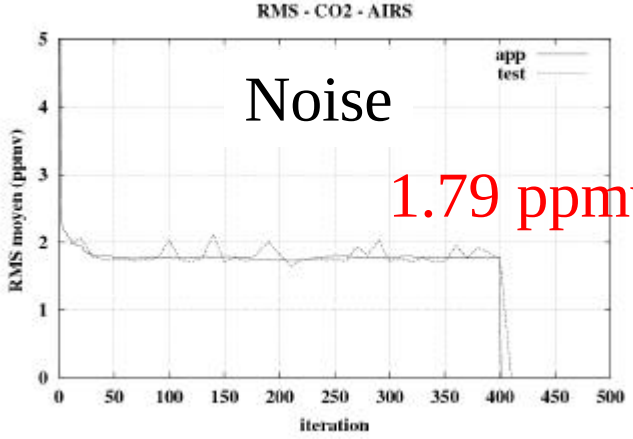
- Trained on the TIGR data set with variable q_{CO2}.
- Noised T_B.

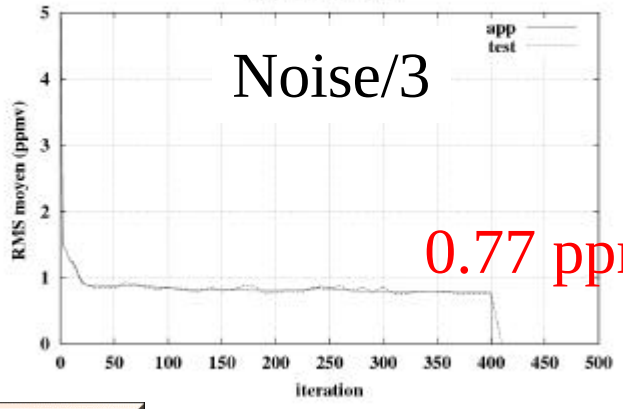
We have trained the NN for only one scan angle and for several sets of inputs and outputs.

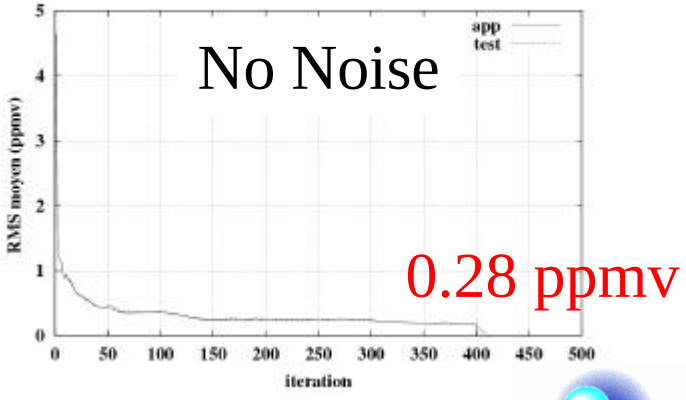
First results….

Training set : 872 Tropical situations.
Inputs : 43 AIRS T_B and 4 surface T_B.

Convergence of the NN







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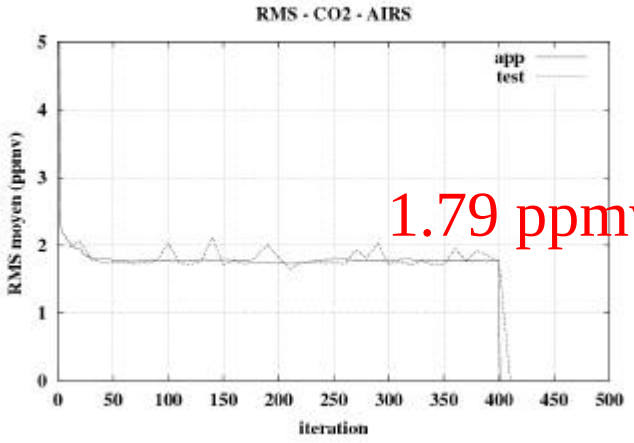
First results….

Training set : 872 Tropical situations.
Inputs : 43 AIRS T_B and 4 surface T_B and 9AMSUA-A T_B.

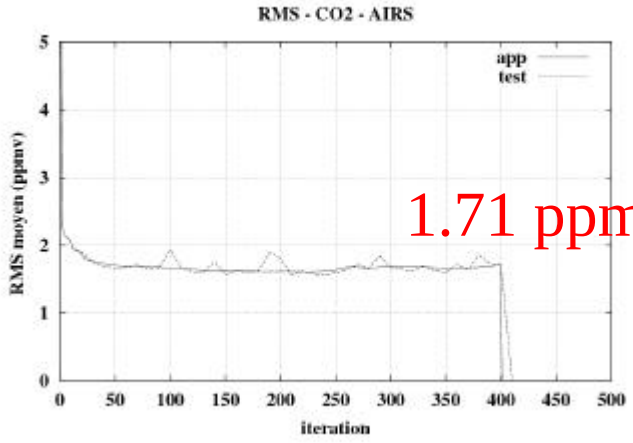
Convergence of the NN

Without AMSU



1.79 ppmv

With AMSU



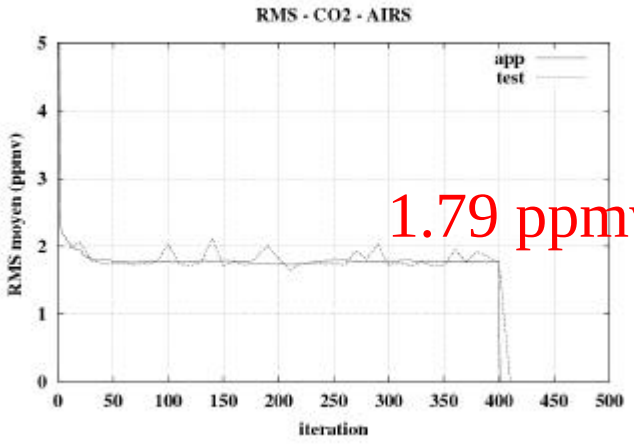
1.71 ppmv

First results….

Training set : 872 Tropical or 742 Temperate situations
Inputs : 43 AIRS T_B and 4 surface T_B.

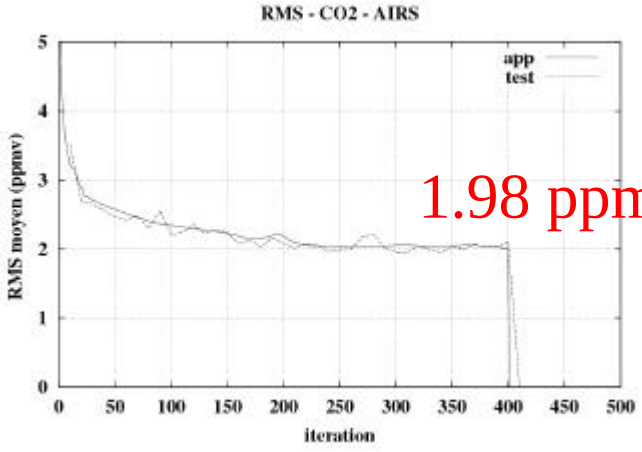
Convergence of the NN

Tropical



1.79 ppmv

Temperate



1.98 ppmv

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I P S L